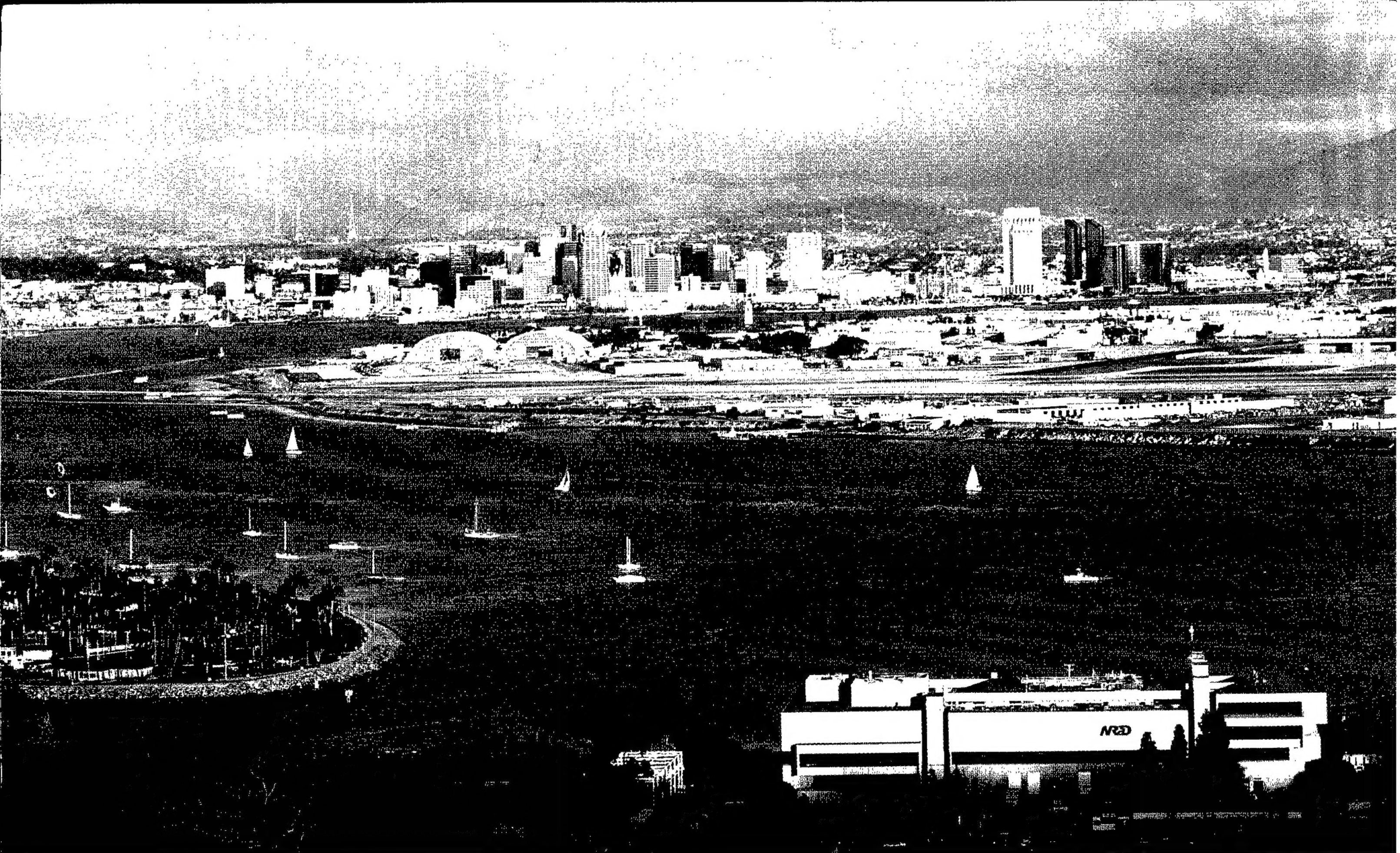

Technical Document 2922
August 1996

Short Segment Data Base

R. Lay

Naval Command, Control and
Ocean Surveillance Center
RDT&E Division

San Diego, CA
92152-5001

Approved for public release; distribution is unlimited.

Technical Document 2922
August 1996

Short Segment Data Base

R. Lay

NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER RDT&E DIVISION
San Diego, California 92152-5001

H. A. Williams, CAPT, USN
Commanding Officer

R. C. Kolb
Executive Director

ADMINISTRATIVE INFORMATION

The work detailed in this report was conducted from April through August 1996. This was a JDL joint services effort with the Rome Laboratory, Griffiss AFB, NY. The work was performed by the Naval Command, Control and Ocean Surveillance Center RDT&E Division, ECM Branch, Code 751, San Diego, CA 92152–5001. Funding was provided under program element 0305885G.

Released by
W. J. Davies, Head
ECM Branch

Under authority of
J. W. Griffin, Head
Electromagnetic/Electro-Optic
Systems Division

ACKNOWLEDGMENTS

The author thanks Bill Fitzgerald of Cubic Communications, Inc., who provided technical support, as well as use of the CDR–3250 Receiver. The author also thanks Ethan Brodsky for use of his SBPLAY audio program.

CONTENTS

OBJECTIVE 1

DATA FORMAT 3

TEST CONFIGURATION AND VALIDATION 5

SUMMARY 15

REFERENCES 17

APPENDICES

A: CODE USED TO CONTROL CUBIC 3250 RECEIVER A-1
B: BATCH FILE USED TO PLAY TIMIT DATA BASE B-1
C: MATLAB CODE FOR GENERATING FREQUENCY SPECTRUMS C-1

Figures

1. Short segment data base example 1
2. System configuration for creating the Short Segment Data Base 3
3. DAT SNR test configuration 5
4. Transferring digital audio from DAT deck to PC 6
5. DAT frequency response to 1-kHz tone 6
6. DAT frequency response 8
7. DAT validation test configuration with noise generator 8
8. Receiver response in AM mode 9
9. Receiver response in LSB mode 9
10. Noise generator replaced with signal generator 10
11. Receiver response to AM 1-kHz tone 10
12. Receiver response to 1-kHz tone on LSB 11
13. Frequency spectrum of DAT tone 11
14. Frequency spectrum of modulated/demodulated tone 12

OBJECTIVE

The objective of this project was to construct the Short Segment Data Base, a data base of short speech segments with various dwell times and various periods. This was accomplished by switching a receiver back and forth between an occupied and an unoccupied frequency. There must be no audio signal present when the receiver is tuned to the unoccupied frequency. This switching technique simulates a scanning receiver recording the audio on a specific frequency during each scan cycle. These audio segments are recorded on one channel of a digital audio tape (DAT) deck. The original, nonsegmented audio is recorded on the other channel.

Figure 1 shows an example of a short speech segment. In the figure, td is the dwell time on a frequency, not including the transients; tt is the time it takes the transients to expire after the receiver switches from one frequency to another; and T is the scan cycle period. This is the time it takes the receiver to revisit the same frequency in its scanning cycle. If N is the number of frequencies scanned per scan cycle, then $T = N\,(td + tt)$. It was necessary to obtain data in which td = 4, 8, 16, 32, 64, 128, and 256 ms. In addition, it was required that N = 5, 10, and 20 for each dwell time. These combinations give a total of 21 sets of data.

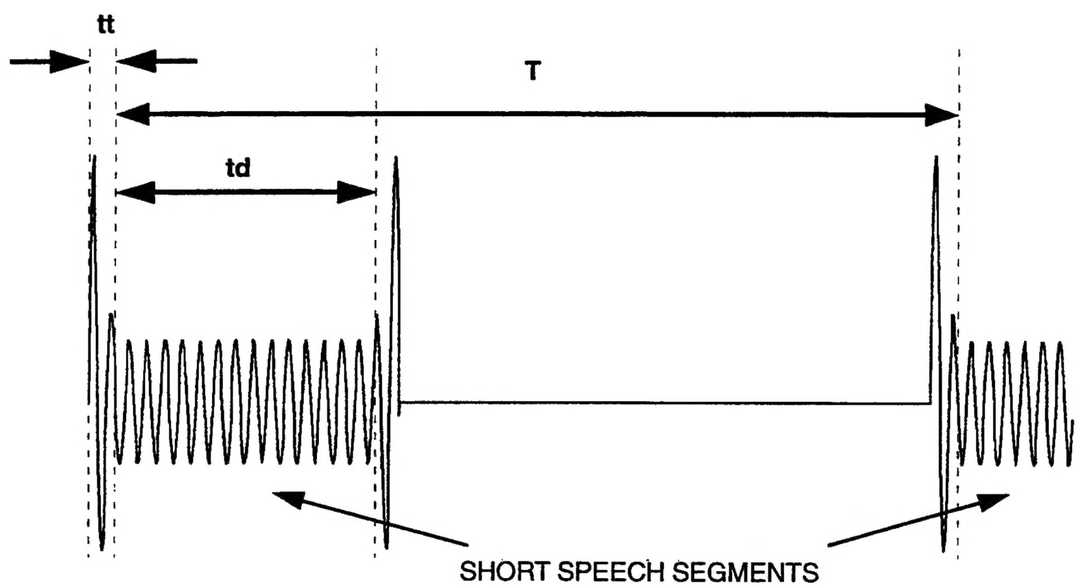

Figure 1. Short segment data base example.

DATA FORMAT

Part one of the Short Segment Data Base was created from the KING data base. This data base consists of speech samples from 26 male speakers, each about 50 seconds long, recorded sequentially on DAT tape. The original KING data base is 22 minutes and 30 seconds long. As stated before, 21 different sets of data were required. Figure 2 shows the equipment configuration used to construct the data base. The KING data base was played 21 times. Each of these times, the PC controlled the switching of the receiver appropriately to achieve the correct dwell times and scan periods. Appendix A shows the code used to control the receiver. The delays were adjusted so that the dwell time, td, and scan cycle period, T, were set appropriately, as observed on an oscilloscope. It was estimated that these values are within 2 percent of the nominal value. The data were recorded at a sample rate of 48 kHz.

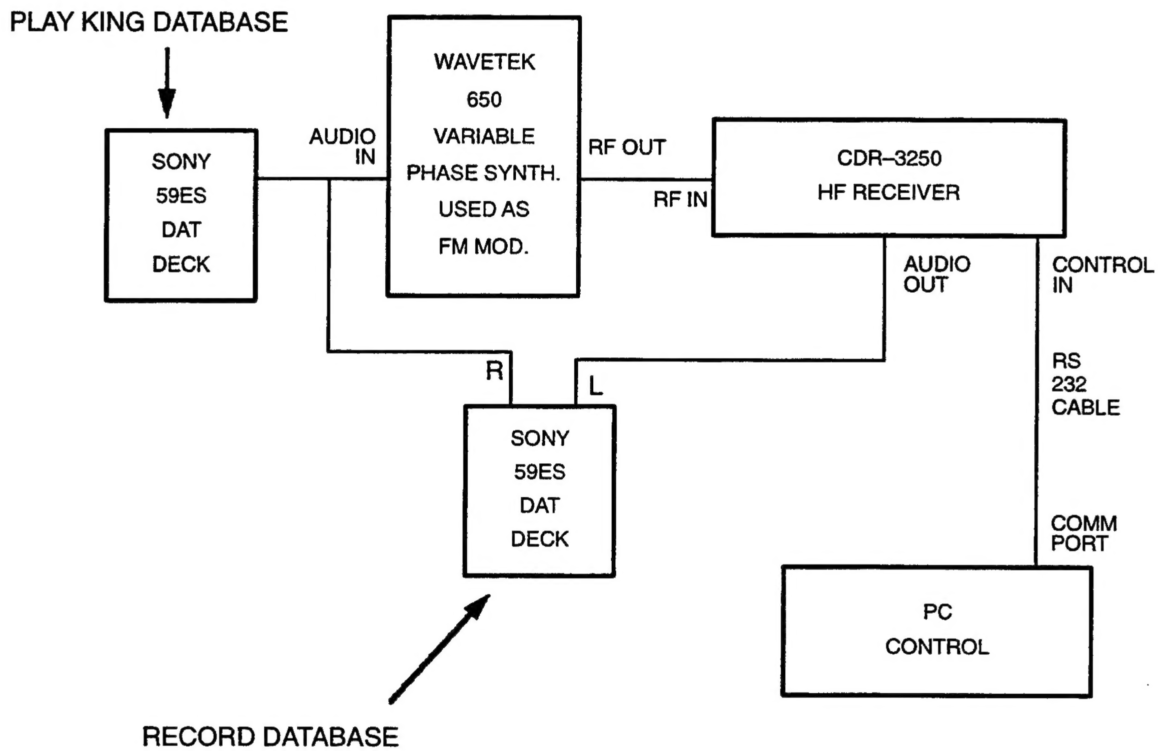

Figure 2. System configuration for creating the Short Segment Data Base.

Part two of the Short Segment Data Base was created from the TIMIT data base. This was stored on a Sun-compatible CD ROM. The sound files stored on the CD had an unknown header format, but had been recorded at 16 kHz with 16-bit precision. Using a program (reference 2) written to play 16-bit sound at any sampling rate, playing the sound files was possible. There are two disadvantages in using this method. The first was that the header of the file was played as well, resulting in an audio pop at the beginning of each audio segment. The second was that recording the sound files onto DAT tape required a digital-to-analog conversion, followed by an analog-to-digital conversion. The first conversion occurs in the sound card of the PC playing the files, and the second occurs in the DAT recording the audio from the sound card. A batch file was written to record audio from 35 speakers from the CD to the DAT. Appendix B shows this batch file. The resulting DAT had 35 speakers, both male and female, each speaking for about 30 seconds. The total time for playing all 35 speakers is 22 minutes and 10 seconds. After

creating this DAT tape from the TIMIT data base, this DAT was played 21 times, and recording part two of the Short Segment Data Base proceeded exactly as part one.

The final product consists of two sets of seven DAT tapes each. Of the seven DAT tapes in each part, there is one tape for each dwell time. In part one, the first 22-minute, 30-second section of each tape corresponds to N = 5. In part two, this section is 22 minutes, 10 seconds. The next two sections of each tape correspond to N = 10 and N = 20. A tone marker, on the nonswitched (right) channel of each tape, indicates the beginning of the next section. These sections are indexed by program numbers. Program numbers 1, 2, and 3 correspond to N = 5, 10, and 20, respectively.

TEST CONFIGURATION AND VALIDATION

Test equipment included the following items:

- Wavetek 650 Variable Phase Synthesizer
- Tektronix 2232 Oscilloscope
- Sony DTC-59ES Digital Audio Tape (DAT) Deck
- Cubic Communications CDR-3250 High Frequency Receiver
- Racal-Dana 9087 Signal Generator
- Micronetics NOD 5200 Noise Generator
- Sound Stage system from Turtle Beach Systems

The Sound Stage system consists of an interface box, an IBM-compatible card, and software. This system can accept digital audio from a DAT tape deck and store the results on a PC hard drive as a sound data file and a sound information file. The sound data file contains the raw samples, while the sound information file contains information such as sampling rate. Plotting the frequency spectrum of a given DAT recording involves playing the DAT tape through the Sound Stage system. Then, a windowed fast Fourier transform (FFT) of the sound data file is taken. Given the sample rate, one may then plot the frequency spectrum as a function of frequency, in Hertz. The windowing and FFT process was done with the MATLAB code shown in Appendix C.

To determine the signal-to-noise ratio (SNR) and Spur-Free Dynamic Range (SFDR) of the DAT deck, a 1-kHz tone generated by the Wavetek 650 Variable Phase Synthesizer was applied to the analog input of the DAT deck (figure 3).

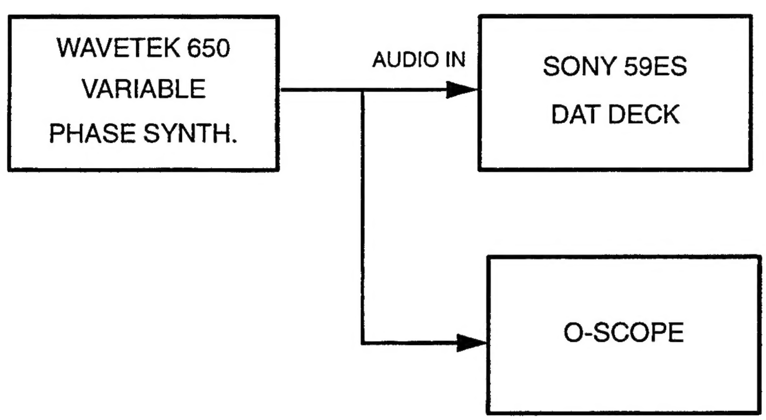

Figure 3. DAT SNR test configuration.

The audio level of this tone was 1.2 volts peak-to-peak, just below analog-to-digital saturation of the DAT deck. The DAT deck recorded this tone onto a DAT tape using a sampling rate of 32 kHz. The DAT tape was then played back, and the data were recorded on a PC hard drive using the Sound Stage system (figure 4). The frequency spectrum of this data is plotted in figure 5. Note the SFDR of about 70 dB.

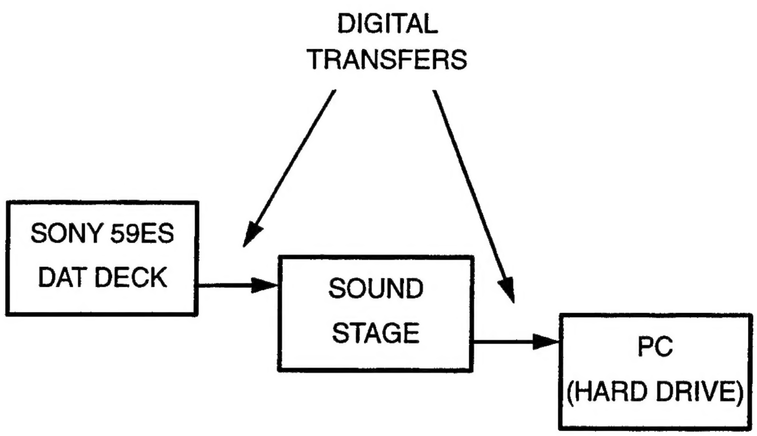

Figure 4. Transferring digital audio from DAT deck to PC.

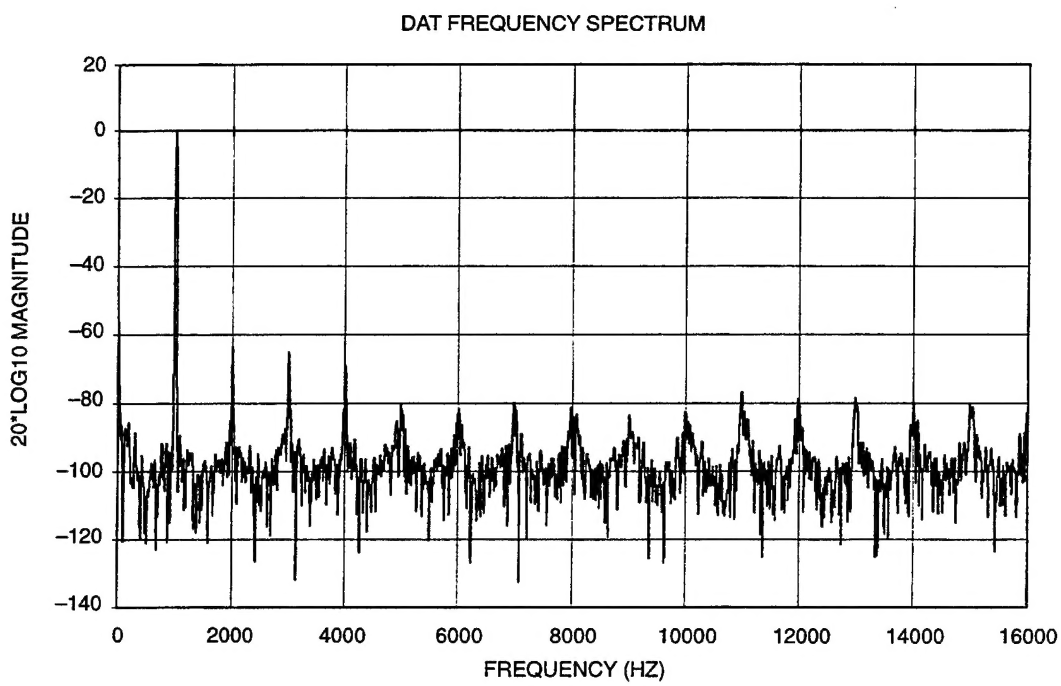

Figure 5. DAT frequency response to 1-kHz tone.

The SNR is estimated as (reference 1):

$$\text{SNR} \cong -\text{Noise Floor Estimate (in dB below tone power)} - 10*\log(\text{FFT length/Equivalent Noise Bandwidth}).$$

Since Noise Floor $\cong -100$ dB,

FFT length $= 4096$ samples,

Equivalent Noise Bandwidth $= 2.00$

(Minimum 4-Sample Blackman-Harris)

$$\text{SNR} \cong 100 \text{ dB} - 10*\log(4096/2.00)$$

$$\cong 67 \text{ dB}.$$

To determine the frequency response of the DAT deck, tones of increasing frequency generated by the Wavetek 650 Variable Phase Synthesizer were applied to the analog input of the DAT deck. The DAT deck again recorded this signal onto tape at 32 kHz. The tape was played back, and using Sound Stage, the data were recorded onto the PC hard drive. Figure 6 shows a plot of the signal magnitude versus frequency.

To examine receiver performance, the Cubic Communications High Frequency (HF) Receiver and the Micronetics NOD 5200 Noise Generator were configured as shown in figure 7. The HF receiver was tuned to 10 MHz, with the Automatic Gain Control (AGC) off. The noise generator was applied to the radio-frequency (RF) input of the receiver. The audio out of the receiver was recorded onto the DAT deck at 32 kHz, and the frequency spectrum plotted. This test was done with the receiver in amplitude modulated (AM) mode, with a bandwidth of 6.0 kHz (figure 8). It was also done in lower sideband (LSB) mode, with a bandwidth of 2.8 kHz (figure 9).

The Micronetics NOD 5200 Noise Generator was replaced with the Racal-Dana 9087 Signal Generator (figure 10). A tone with a frequency of 10 MHz and an amplitude of 1.0 mV was applied to the RF input of the receiver. This tone was AM modulated at 75% modulation with a 1-kHz tone. The receiver was set to AM, 6-kHz bandwidth, and no AGC. The audio out of the receiver was recorded with the DAT deck. Figure 11 shows the spectrum. The SNR is estimated from this plot.

Since Noise Floor $\cong -85$ dB,

FFT length $= 4096$ samples,

Equivalent Noise Bandwidth $= 2.00$

(Minimum 4-Sample Blackman-Harris)

$$\text{SNR} \cong 85 \text{ dB} - 10*\log(4096/2.00)$$

$$\cong 52 \text{ dB}.$$

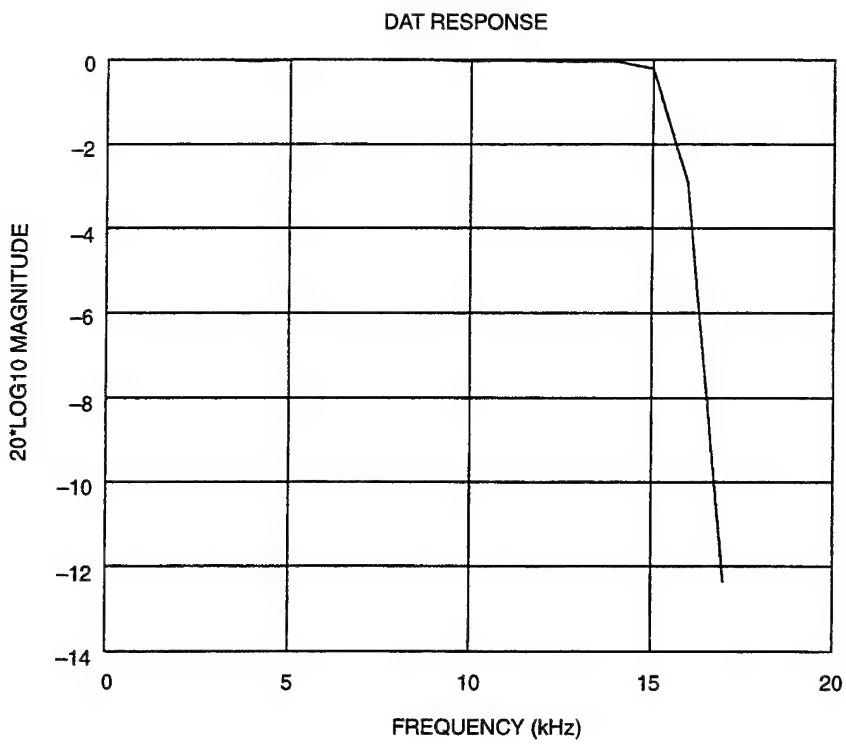

Figure 6. DAT frequency response.

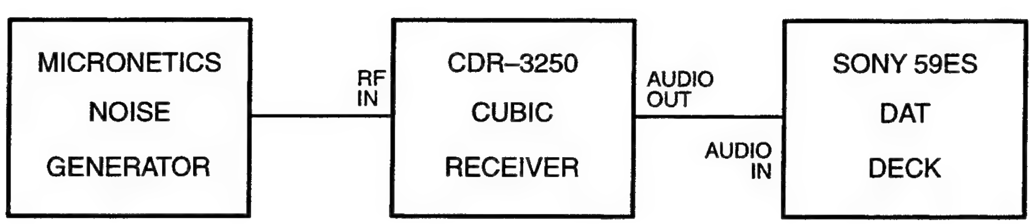

Figure 7. DAT validation test configuration with noise generator.

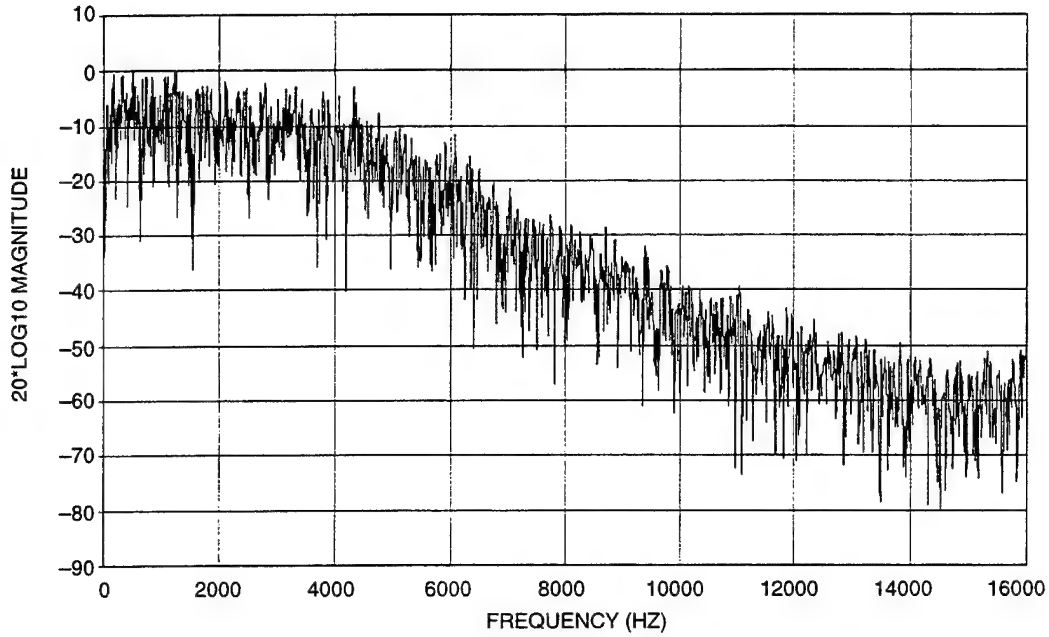

Figure 8. Receiver response in AM mode.

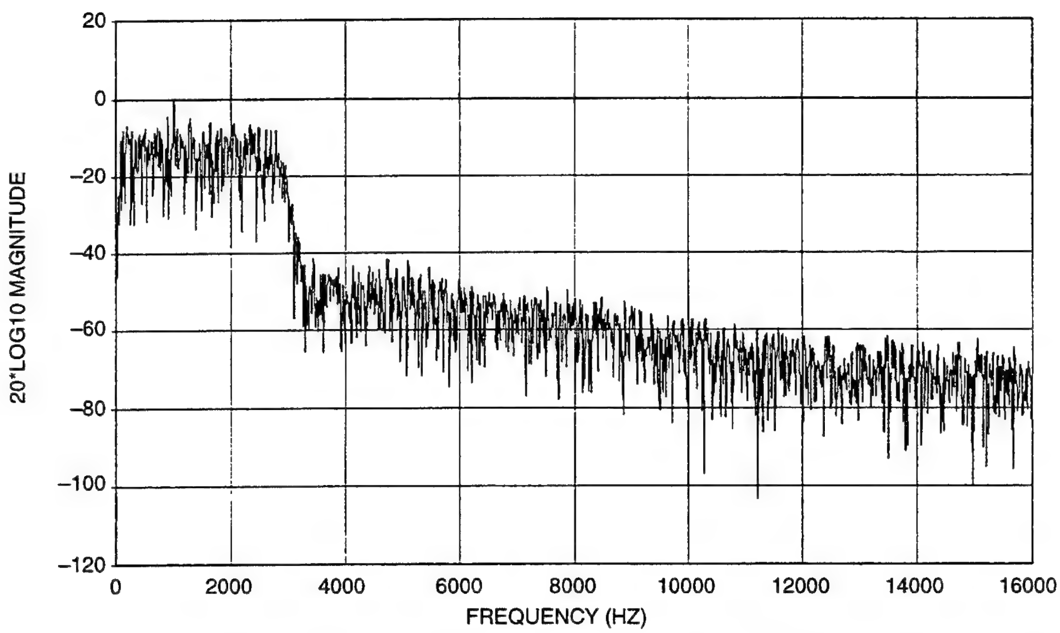

Figure 9. Receiver response in LSB mode.

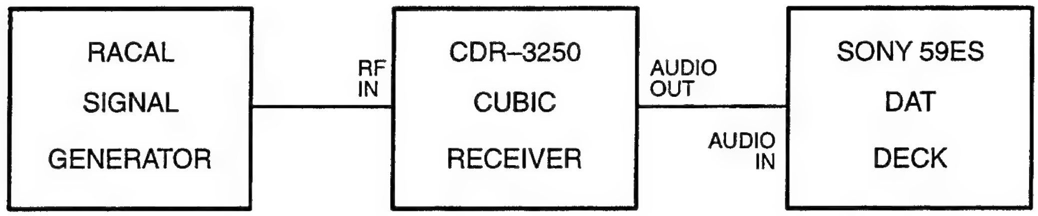

Figure 10. Noise generator replaced with signal generator.

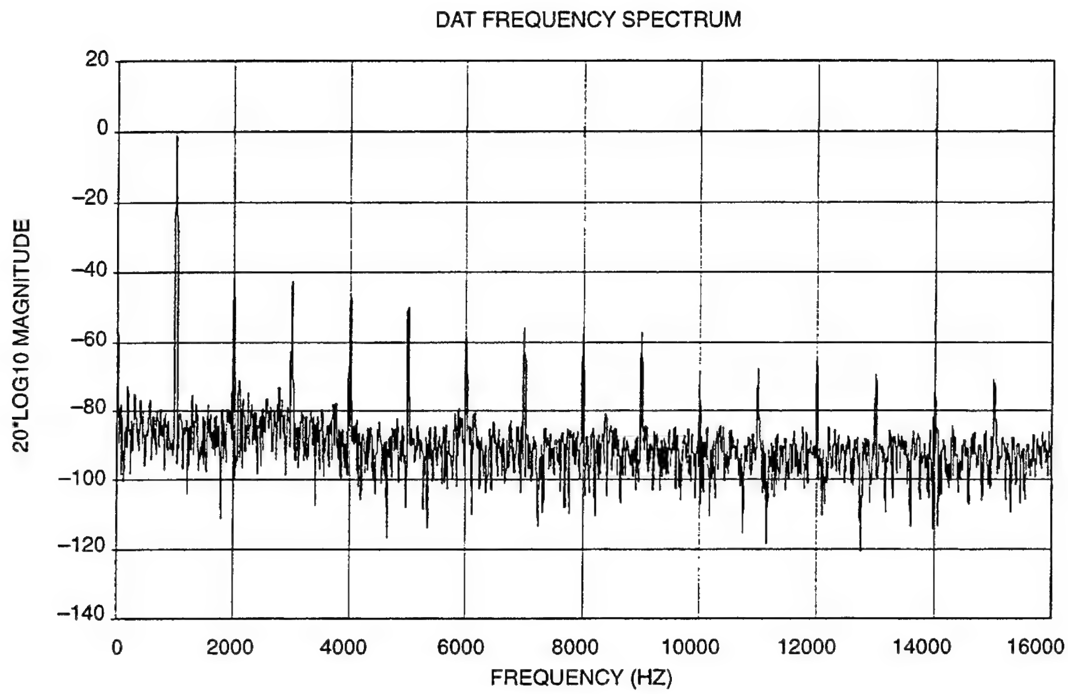

Figure 11. Receiver response to AM 1-kHz tone.

Next, the AM modulation was removed from the 10-MHz tone, and the receiver was placed in LSB mode, 2.8-kHz bandwidth, and no AGC. The receiver was tuned to 10.001 MHz, and the 1-kHz offset manifested itself as a 1-kHz tone at the audio out of the receiver. This was recorded with the DAT deck, and the frequency spectrum plotted as before (figure 12). The SNR estimated from this plot was 42 dB.

Finally, the system was tested precisely as it was to be used in creating the data base. Figure 2 shows the setup. The Wavetek 650 Variable Phase Synthesizer was set to frequency modulation (FM) (sweep mode 12), a span frequency of 5 kHz, a center frequency of 1.5 MHz, no compensation, and an amplitude of 300 mV (peak-to-peak, into 50 ohms), with the audio from the DAT deck connected to the frequency modulation/phase modulation (FM/PM) input of the Wavetek 650 Variable Phase Synthesizer. The output went to the Cubic Communications CDR-3250 HF Receiver. The receiver was set for no AGC, an 8-kHz bandwidth, and was placed in FM mode. A tone previously recorded on the DAT was input into the Wavetek, FM modulated by the Wavetek, demodulated by the receiver, and recorded on another DAT. This recording DAT deck was set to sample at 48 kHz. The frequency spectrum of the original tone and the modulated-demodulated tone are shown in figures 13 and 14, respectively.

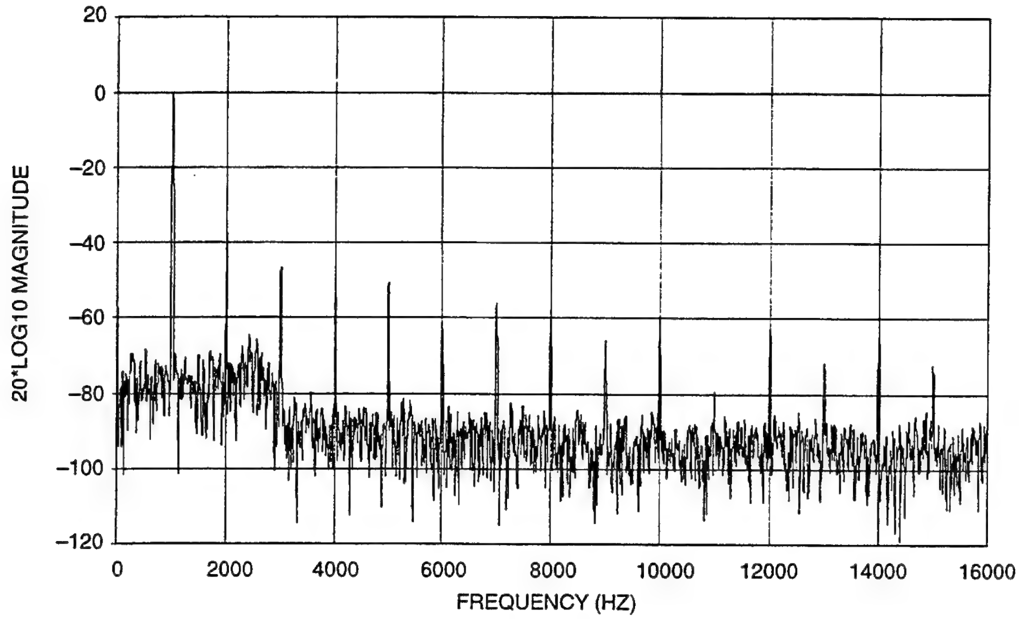

Figure 12. Receiver response to 1-kHz tone on LSB.

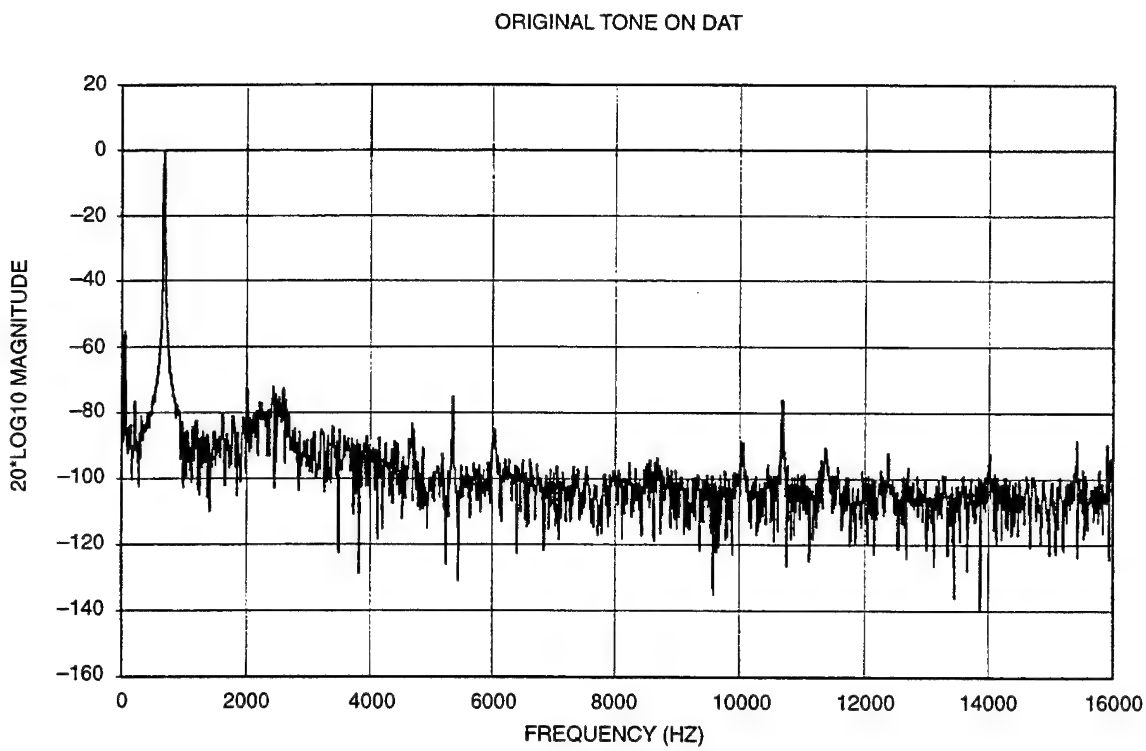

Figure 13. Frequency spectrum of DAT tone.

From figure 13:

Since	Noise Floor		$\cong$ –90 dB,
	FFT length		= 4096 samples,
	Equivalent Noise Bandwidth		= 2.00
	(Minimum 4-Sample Blackman-Harris)		

$$\text{SNR} \cong 90\text{ dB} - 10{*}\log(4096/2.00)$$
$$\cong 57\text{ dB.}$$

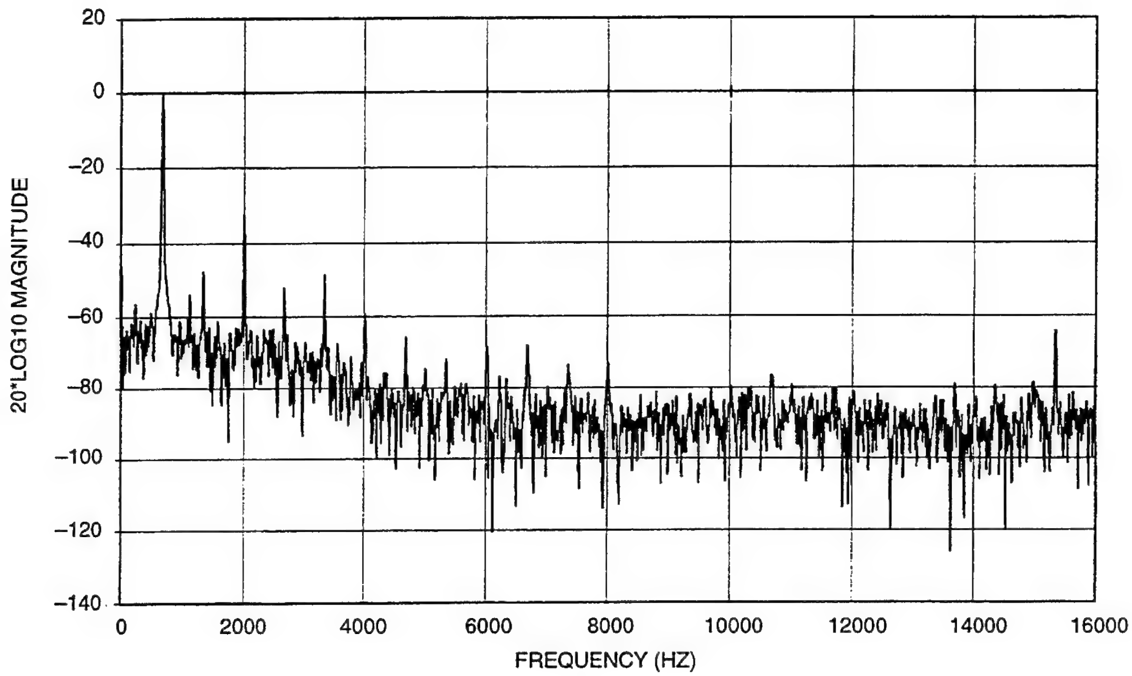

Figure 14. Frequency spectrum of modulated/demodulated tone.

From figure 14:

Since	Noise Floor		$\cong$ –65 dB,
	FFT length		= 4096 samples,
	Equivalent Noise Bandwidth		= 2.00
	(Minimum 4-Sample Blackman-Harris)		

$$\text{SNR} \cong 65\text{ dB} - 10{*}\log(4096/2.00)$$
$$\cong 32\text{ dB.}$$

As shown in the above calculations, the SNR of the original tone recorded on DAT tape is 57 dB. After modulation and demodulation, the SNR is 32 dB.

As stated earlier, figure 2 shows the configuration used to create the Short Segment Data Base. The variable phase synthesizer and the receiver settings were described earlier. The DAT deck left and right recording levels were set so that the left input equaled the right input. Then, both knobs were adjusted

so that the signal coming directly from the playing DAT deck was just shy of saturating the right channel of the recording DAT deck. This was setting 4 on the DAT deck. Then, the computer began switching the receiver between 1.5 MHz (the occupied channel) and 1.4 MHz (the unoccupied channel). Appendix A provides the code used to control the receiver. The audio out of the receiver went to the DAT deck. This audio out was adjusted at the receiver until it was just shy of saturating the left channel of the recording DAT deck.

SUMMARY

A Short Segment Data Base has been developed, with dwell times of 4, 8, 16, 32, 64, 128, and 256 ms. For each dwell time, the number of frequencies scanned per scan cycle (simulated) was 5, 10, and 20 frequencies. The data base was recorded on 14 DAT tapes. Part one of the Short Segment Data Base consists of seven DAT tapes, and is derived from the KING data base. The second part, consisting of the remaining seven DAT tapes, is derived from the TIMIT data base. Of the seven DAT tapes in each part, there is one for each dwell time.

REFERENCES

1. Harris, F. J. 1978. "On the Use of Windows for Harmonic Analysis with the Discrete Fourier Transform," *Proceedings of the IEEE* (Jan.), vol. 66, no. 1, pp. 51-83.

2. Brodsky, E. 1995. SBPLAY audio program used to play 16-bit audio files.

APPENDIX A

CODE USED TO CONTROL CUBIC 3250 RECEIVER

```
'     3150_C2.BAS          7-8-96

          'Controlls CUBIC 3150 / 3250 Receiver.

DEFINT I-N
 CLS
 PRINT "CUBIC 3250 CONTROL, Rich's version *********************"

  PRINT "ENTERING SWITCHING MODE"
  INPUT "ENTER INITIAL DELAY1"; DELAY1
  INPUT "ENTER INITIAL DELAY2"; DELAY2
  OPEN "COM2:19200, N,8,1,CD0,CS0,DS0" FOR RANDOM AS #1
  CS$ = CHR$(2) + "000"
  PRINT #1, CS$ + ":NORM"
  PRINT #1, CS$ + "FAQ1"
  FIRST$ = CS$ + "RC1"
  SECOND$ = CS$ + "RC0"
10  X$ = INKEY$
  SELECT CASE X$
   CASE IS = "S": GOTO 20
   CASE IS = "E": DELAY1 = DELAY1 + 10
   CASE IS = "R": DELAY1 = DELAY1 - 10
   CASE IS = "T": DELAY2 = DELAY2 + 10
   CASE IS = "Y": DELAY2 = DELAY2 - 10
   CASE IS = "D": DELAY1 = DELAY1 + 1
   CASE IS = "F": DELAY1 = DELAY1 - 1
   CASE IS = "G": DELAY2 = DELAY2 + 1
   CASE IS = "H": DELAY2 = DELAY2 - 1
   CASE IS = "P"
        PRINT "DELAY1 = "; DELAY1,
        PRINT "DELAY2 = "; DELAY2
```

```
    END SELECT
    IF DELAY1 <= 0 THEN DELAY1 = 0
    IF DELAY2 <= 0 THEN DELAY2 = 0
    PRINT #1, FIRST$
    FOR I = 1 TO DELAY1: XX = COS(1): NEXT I
    PRINT #1, SECOND$
    FOR I = 1 TO DELAY2: XX = COS(1): NEXT I
    GOTO 10
20  CLOSE #1
    PRINT "DELAY1 = "; DELAY1,
    PRINT "DELAY2 = "; DELAY2
    PRINT "FINISHED"
```

APPENDIX B

BATCH FILE USED TO PLAY TIMIT DATA BASE

```
rem marker tone
rem dat input to 5
cd ..
sbplay 32000 v1k.sfd
pause
rem dat input to 10
rem speaker 1
e:
cd e:\timit\test\dr1\faks0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1573.wav
sbplay 16000 si2203.wav
sbplay 16000 sx133.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1573.wav
sbplay 16000 si2203.wav
sbplay 16000 sx133.wav
pause
rem speaker 2
cd e:\timit\test\dr1\fdac1
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1474.wav
sbplay 16000 si2104.wav
sbplay 16000 sx214.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1474.wav
sbplay 16000 si2104.wav
sbplay 16000 sx214.wav
pause
rem speaker 3
cd e:\timit\test\dr1\felc0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1386.wav
sbplay 16000 si2016.wav
sbplay 16000 sx306.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1386.wav
sbplay 16000 si2016.wav
sbplay 16000 sx306.wav
pause
rem speaker 4
cd e:\timit\test\dr1\fjem0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1264.wav
sbplay 16000 si634.wav
sbplay 16000 sx364.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1264.wav
sbplay 16000 si634.wav
sbplay 16000 sx364.wav
pause
rem speaker 5
cd e:\timit\test\dr1\mdab0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1039.wav
sbplay 16000 si1669.wav
sbplay 16000 sx49.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1039.wav
sbplay 16000 si1669.wav
sbplay 16000 sx49.wav
pause
rem speaker 6
cd e:\timit\test\dr1\mjsw0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1010.wav
sbplay 16000 si2270.wav
sbplay 16000 sx380.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1010.wav
sbplay 16000 si2270.wav
sbplay 16000 sx380.wav
pause
rem speaker 7
cd e:\timit\test\dr1\mreb0
```

```
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1375.wav
sbplay 16000 si745.wav
sbplay 16000 sx385.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1375.wav
sbplay 16000 si745.wav
sbplay 16000 sx385.wav
pause
rem speaker 8
cd e:\timit\test\dr1\mrjo0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1624.wav
sbplay 16000 si734.wav
sbplay 16000 sx374.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1624.wav
sbplay 16000 si734.wav
sbplay 16000 sx374.wav
pause
rem speaker 9
cd e:\timit\test\dr1\msjs1
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si639.wav
sbplay 16000 si869.wav
sbplay 16000 sx99.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si639.wav
sbplay 16000 si869.wav
sbplay 16000 sx99.wav
pause
rem speaker 10
cd e:\timit\test\dr1\mstk0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1024.wav
sbplay 16000 si2222.wav
sbplay 16000 sx34.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1024.wav
sbplay 16000 si2222.wav
sbplay 16000 sx34.wav
pause
rem speaker 11
cd e:\timit\test\dr2\fdrd1
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1566.wav
sbplay 16000 si2149.wav
sbplay 16000 sx194.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1566.wav
sbplay 16000 si2149.wav
sbplay 16000 sx194.wav
pause
rem speaker 12
cd e:\timit\test\dr2\fjre0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1116.wav
sbplay 16000 si1587.wav
sbplay 16000 sx.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1116.wav
sbplay 16000 si1587.wav
sbplay 16000 sx.wav
pause
rem speaker 13
cd e:\timit\test\dr2\fpas0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1272.wav
sbplay 16000 si2204.wav
sbplay 16000 sx44.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1272.wav
sbplay 16000 si2204.wav
sbplay 16000 sx44.wav
pause
rem speaker 14
cd e:\timit\test\dr2\mabw0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1230.wav
sbplay 16000 si1664.wav
sbplay 16000 sx44.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1230.wav
```

```
sbplay 16000 si1664.wav
sbplay 16000 sx44.wav
pause
rem speaker 15
cd e:\timit\test\dr2\mccs0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si2099.wav
sbplay 16000 si1469.wav
sbplay 16000 sx389.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si2099.wav
sbplay 16000 si1469.wav
sbplay 16000 sx389.wav
pause
rem speaker 16
cd e:\timit\test\dr2\mdbb0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1195.wav
sbplay 16000 si1825.wav
sbplay 16000 sx115.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1195.wav
sbplay 16000 si1825.wav
sbplay 16000 sx115.wav
pause
rem speaker 17
cd e:\timit\test\dr2\mgwt0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si2169.wav
sbplay 16000 si909.wav
sbplay 16000 sx99.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si2169.wav
sbplay 16000 si909.wav
sbplay 16000 sx99.wav
pause
rem speaker 18
cd e:\timit\test\dr3\fcmh0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1454.wav
sbplay 16000 si2084.wav
sbplay 16000 sx374.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1454.wav
sbplay 16000 si2084.wav
sbplay 16000 sx374.wav
pause
rem speaker 19
cd e:\timit\test\dr3\fkms0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1490.wav
sbplay 16000 si2120.wav
sbplay 16000 sx50.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1490.wav
sbplay 16000 si2120.wav
sbplay 16000 sx50.wav
pause
rem speaker 20
cd e:\timit\test\dr3\mgjf0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1901.wav
sbplay 16000 si641.wav
sbplay 16000 sx371.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1901.wav
sbplay 16000 si641.wav
sbplay 16000 sx371.wav
pause
rem speaker 21
cd e:\timit\test\dr3\mlnt0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1574.wav
sbplay 16000 si1902.wav
sbplay 16000 sx372.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1574.wav
sbplay 16000 si1902.wav
sbplay 16000 sx372.wav
pause
rem speaker 22
cd e:\timit\test\dr3\mmwh0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1089.wav
```

```
sbplay 16000 si1301.wav
sbplay 16000 sx99.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1089.wav
sbplay 16000 si1301.wav
sbplay 16000 sx99.wav
pause
rem speaker 23
cd e:\timit\test\dr4\fmcm0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1180.wav
sbplay 16000 si1810.wav
sbplay 16000 sx10.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1180.wav
sbplay 16000 si1810.wav
sbplay 16000 sx10.wav
pause
rem speaker 24
cd e:\timit\test\dr4\mbns0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1220.wav
sbplay 16000 si1850.wav
sbplay 16000 sx.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1220.wav
sbplay 16000 si1850.wav
sbplay 16000 sx.wav
pause
rem speaker 25
cd e:\timit\test\dr4\mkcl0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1091.wav
sbplay 16000 si1721.wav
sbplay 16000 sx281.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1091.wav
sbplay 16000 si1721.wav
sbplay 16000 sx281.wav
pause
rem speaker 26
cd e:\timit\test\dr4\mlll0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1363.wav
sbplay 16000 si1993.wav
sbplay 16000 sx733.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1363.wav
sbplay 16000 si1993.wav
sbplay 16000 sx733.wav
pause
rem speaker 27
cd e:\timit\test\dr5\fasw0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1550.wav
sbplay 16000 si2180.wav
sbplay 16000 sx290.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1550.wav
sbplay 16000 si2180.wav
sbplay 16000 sx290.wav
pause
rem speaker 28
cd e:\timit\test\dr5\mahh0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1924.wav
sbplay 16000 si664.wav
sbplay 16000 sx394.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1924.wav
sbplay 16000 si664.wav
sbplay 16000 sx394.wav
rem speaker 29
cd e:\timit\test\dr5\mcrc0
pause
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1722.wav
sbplay 16000 si462.wav
sbplay 16000 sx102.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1722.wav
sbplay 16000 si462.wav
sbplay 16000 sx102.wav
pause
```

```
rem speaker 30
cd e:\timit\test\dr6\fmgd
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1564.wav
sbplay 16000 si2194.wav
sbplay 16000 sx394.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1564.wav
sbplay 16000 si2194.wav
sbplay 16000 sx394.wav
pause
rem speaker 31
cd e:\timit\test\dr6\mesd0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1632.wav
sbplay 16000 si2262.wav
sbplay 16000 sx102.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1632.wav
sbplay 16000 si2262.wav
sbplay 16000 sx102.wav
pause
rem speaker32
cd e:\timit\test\dr7\fisb0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1579.wav
sbplay 16000 si2209.wav
sbplay 16000 sx49.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1579.wav
sbplay 16000 si2209.wav
sbplay 16000 sx49.wav
pause
rem speaker 33
cd e:\timit\test\dr7\mrpc0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si493.wav
sbplay 16000 si933.wav
sbplay 16000 sx43.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si493.wav
sbplay 16000 si933.wav
sbplay 16000 sx43.wav
pause
rem speaker 34
cd e:\timit\test\dr8\mres0
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1217.wav
sbplay 16000 si1847.wav
sbplay 16000 sx47.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si1217.wav
sbplay 16000 si1847.wav
sbplay 16000 sx47.wav
pause
rem speaker 35
cd e:\timit\test\dr8\mdaw1
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si2083.wav
sbplay 16000 si1453.wav
sbplay 16000 sx13.wav
sbplay 16000 sa1.wav
sbplay 16000 sa2.wav
sbplay 16000 si2083.wav
sbplay 16000 si1453.wav
sbplay 16000 sx13.wav
d:
cd pete
```

APPENDIX C

MATLAB CODE FOR GENERATING FREQUENCY SPECTRUMS

```
function [maximum] = getit(filename,heading)
fid = fopen(['d:\',filename,'.sfd'],'r');
if (fid == -1)
        error('fid = -1, error opening file')
        end
[b,count] = fread(fid,2048,'short');
if (count ~= 2048)
        error('something wrong with the file read')
        end
[a,count] = fread(fid,4096,'short');
if (count ~= 4096)
        error('something wrong with the file read')
        end
fclose(fid);
window = nuttall(4096);
mag = abs(fft(a.*window));
maximum = max(abs(a));
x = (1:count/2)*32000/4096;
y = (20*log10(mag((1:count/2),1)/max(mag)))';
z = [x ; y];
fid = fopen('d:\pete\test.123','w');
if (fid == -1)
        error('fid = -1, error opening file for writing')
        end
fprintf(fid,'%8.4f %12.8f\n',z);
fclose(fid);
```

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
August 1996

3. REPORT TYPE AND DATES COVERED
Final: April–August 1996

4. TITLE AND SUBTITLE
SHORT SEGMENT DATA BASE

5. FUNDING NUMBERS
PE: 0305885G

6. AUTHOR(S)
R. Lay

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Command, Control and Ocean Surveillance Center (NCCOSC)
RDT&E Division
San Diego, California 92152–5001

8. PERFORMING ORGANIZATION REPORT NUMBER
TD 2922

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
National Security Agency
Central Security Service
9800 Savage Road
Ft. George G. Meade, MD 20755

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The objective of this project was to construct the Short Segment Data Base, a data base of short speech segments with various dwell times and various periods. This was accomplished by switching a receiver back and forth between an occupied and an unoccupied frequency. There must be no audio signal present when the receiver is tuned to the unoccupied frequency. This switching technique simulates a scanning receiver recording the audio on a specified frequency during each scan cycle. These audio segments are recorded on one channel of a digital audio tape (DAT) deck. The original, nonsegmented audio is recorded on the other channel.

A Short Segment Data Base has been developed, with dwell times of 4, 8, 16, 32, 64, 128, and 256 ms. For each dwell time, the number of frequencies scanned per scan cycle (simulated) was 5, 10, and 20 frequencies. The data base was recorded on 14 DAT tapes. Part one of the Short Segment Data Base consists of seven DAT tapes, and is derived from the KING data base. The second part, consisting of the remaining seven DAT tapes, is derived from the TIMIT data base. Of the seven DAT tapes in each part, there is one for each dwell time.

14. SUBJECT TERMS
Mission Area: Surveillance
short speech segment
digital audio tape (DAT)
dwell time
KING data base
TIMIT data base

15. NUMBER OF PAGES
30

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAME AS REPORT

21a. NAME OF RESPONSIBLE INDIVIDUAL	21b. TELEPHONE *(include Area Code)*	21c. OFFICE SYMBOL
R. Lay	(619) 553–2983	Code 751

INITIAL DISTRIBUTION

Code 0012	Patent Counsel	(1)
Code 0271	Archive/Stock	(6)
Code 0274	Library	(2)
Code 70	J. A. Salzmann	(1)
Code 75	J. W. Griffin	(1)
Code 7502	B. R. Hunt	(1)
Code 751	J. Davies	(1)
Code 751	P. C. Grossnickle	(5)
Code 751	R. Lay	(2)
Code 772	W. S. Bratt	(1)
Code 804	R. D. Peterson	(1)

Defense Technical Information Center
Alexandria, VA 22304–6145 (4)

NCCOSC Washington Liaison Office
Washington, DC 20363–5100

Center for Naval Analyses
Alexandria, VA 22302–0268

Navy Acquisition, Research and Development
Information Center (NARDIC)
Arlington, VA 22244–5114

GIDEP Operations Center
Corona, CA 91718–8000

Office of Naval Research
Arlington, VA 22217–5000

Naval Research Laboratory
Washington, DC 20375–5000

Space and Naval Warfare Systems Command
Arlington, VA 22245–5200 (2)

Naval Security Group Command
Washington, DC 20393–5100 (3)

Joint Electronic Warfare Center
San Antonio, TX 78243

Wright Research & Development Center
Wright Patterson AFB, OH 45433–7318 (2)

Rome Air Development Center
Griffiss AFB, NY 13441 (3)

U.S.A. SSD
Center for Signal Warfare
Warington, VA 22815–5124 (1)